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(54) **MOBILE COMPUTING DEVICE WITH DATA COGNITION SOFTWARE**

(57) A mobile computing device enabled by a customizable data cognition layer (DCL) software program to convert input information from a variety of sensors into real-time contextual messages is disclosed. The DCL

software incorporates customizable software components known as plug-ins to expand the use of the mobile computing device.

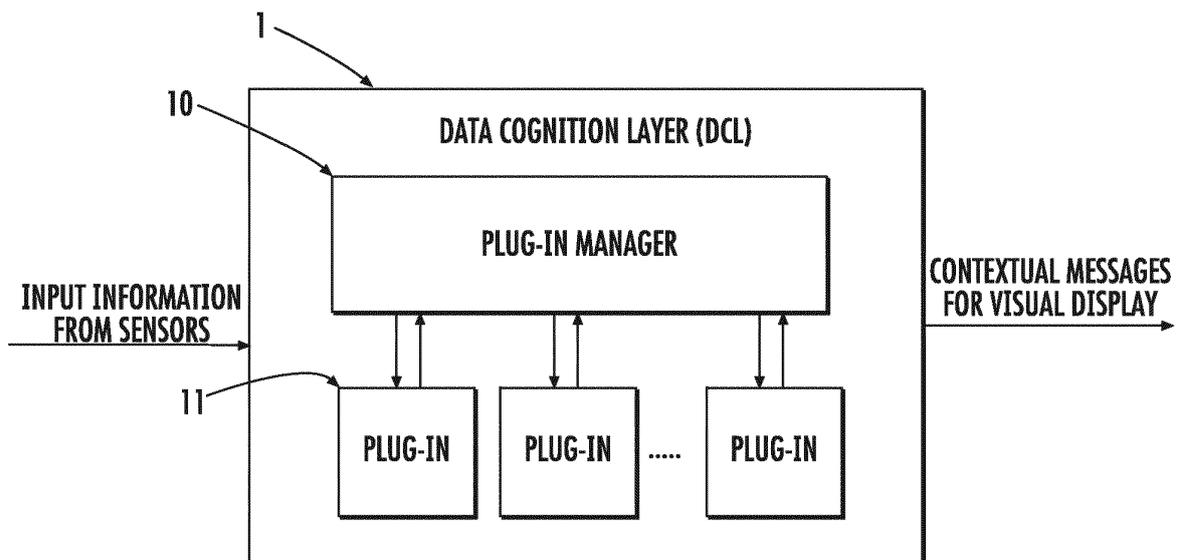


FIG. 1

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DescriptionFIELD OF THE INVENTION

[0001] The present invention relates to mobile computing devices (e.g., barcode readers), and more specifically, to a mobile computing device with data cognition software stored in memory that configures a processor to convert low level information from sensors into a predetermined action, designed to operate on a particular data type.

BACKGROUND

[0002] Generally speaking, a worker is faced with many pieces of information in the course of their work. Each piece of information can be used individually or in combination to help the worker be more productive at their job. This information is often coded or in a raw state. In either case, the information may be hard to use. One way to increase productivity is to utilize a mobile computing device for collecting, aggregating, and inferring context from this information. The mobile computing device may then present timely and informative contextual messages to the user, thereby allowing the worker to become more knowledgeable and efficient.

[0003] Not all work environments are the same. As a result, the mobile computing device must also be highly configurable in order to address the particular requirements of a work environment.

[0004] A need, therefore, exists for a mobile computing device that utilizes customizable data cognition software to convert sensed information into timely contextual messages that are easily understood by a worker.

SUMMARY

[0005] Accordingly, in one aspect, the present invention embraces a mobile computing device including a user-interface (UI) system, a communication module, a memory, and a processor. The UI system includes input sensors (e.g., digital camera, GPS receiver, touch-screen, RTLS device, and/or microphone) for capturing input information. The UI system also includes a visual display (e.g., touch screen display) for displaying digital images and contextual messages to a user. The communication module facilitates the transmission and reception of information to and from a remote device (e.g., database storage system). The mobile computing device includes memory for storing a data cognition layer (DCL) software program. The DCL software program is executed by the processor to (i) receive the input information from the input sensors, (ii) recognize the input information, (iii) transform the input information into information elements, (iv) convert the information elements into contextual messages, and (v) to format data, send data to a remote server, log data, make the device buzz, or any other operation that takes the sensor data as an

input (e.g., transmit the contextual messages to the UI system for display).

[0006] In an exemplary embodiment, The DCL program includes software plug-ins for creating contextual messages from the input information and a plug-in manager software for coordinating the execution of the software plug-ins as well as the software plug-in communication (e.g., the exchange of information between the software plug-ins).

[0007] In another aspect, the present invention embraces a mobile computing device (MCD) including a user-interface (UI) system integrated with at least one input sensor (e.g., digital camera) for capturing input information (e.g., video stream of real-time images) and integrated with a visual display and touch screen for displaying images and generating touch information in response to a touch. The MCD includes a memory for storing a local data cognition layer (DCL) software program and a communication module for facilitating communication between the MCD and a cloud DCL software program executed by a remote computing device. The remote computing device is connected to the MCD via a network. The MCD includes a processor connected to the UI system, the memory, and the communication module. The processor is configured for executing the local DCL software program to (i) receive the input information and touch information from the UI system's digital camera and touch screen, (ii) communicate the input information and touch information to the cloud DCL software program via the communication module, (iii) receive contextual messages from the cloud DCL software program via the communication module, and (iv) transmit the contextual messages to the UI system's visual display.

[0008] The foregoing illustrative summary, as well as other exemplary objectives and/or advantages of the invention, and the manner in which the same are accomplished, are further explained within the following detailed description and its accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS**[0009]**

Fig. 1 schematically depicts the data cognition layer software framework.

Fig. 2 graphically depicts an exemplary image of a barcoded driver's license with a contextual message.

Fig. 3 graphically depicts an exemplary image of a patient barcode with a contextual message.

Fig. 4 schematically depicts an exemplary embodiment of the mobile computing device with local data cognition.

Fig. 5 schematically depicts an exemplary embodi-

ment of the mobile computing device with remote data cognition.

DETAILED DESCRIPTION

[0010] The present invention embraces a mobile computing device enabled by a customizable data cognition layer (DCL) software program to convert input information from sensors into contextual messages for a user. The DCL software incorporates software plug-ins, which are specialized software components that expand the use of the mobile computing device.

[0011] The mobile computing device includes a user-interface (UI) system. The UI system typically includes at least one sensor for capturing input information and a visual display for displaying digital images and contextual messages to a user. A typical sensor is a digital camera. Here the input information are real-time video images of the camera's field of view. This input information could be printed or displayed symbols (e.g., barcodes), a recognizable object (e.g., a particular product), or could be a user's behavior. The user's behavior may include motion (e.g., hand motion), touch (e.g., finger touch), voice information (e.g., audible command), or eye gestures (e.g., eye gaze). In some cases, other sensors may be included with, or used separately from, the digital camera. For example, a barcode scanner (e.g., laser barcode scanner) could be used to obtain barcode information, while a global positioning system (GPS) or a real-time locating system (RTLS) could be used to obtain the mobile computing device's location.

[0012] The UI system's visual display usually includes a touch screen to capture a user's response to a prompt. The user's response could be multi-touch gestures (e.g., double tap). The visual display typically displays real-time video images of the camera's field of view. When a recognizable object (e.g., a barcode) is present in the images, the DCL software generates a contextual message for display. This contextual message is typically displayed superimposed on the real-time video images in a way that also provides information. For example, if multiple recognizable objects (e.g., barcodes) are found in the camera's images and each generates a contextual message, then each message may be displayed over the appropriate object in order to indicate an association between the contextual message and the object. Sometimes, the contextual message will include a prompt requesting a user response (e.g., immediate response). For example a graphical button indicating that further information is available may be presented on the display, and a user may choose to access this information by pressing the graphical button.

[0013] The mobile computing device includes memory that stores the DCL software program. The memory is accessible by a processor that is configured for executing the DCL software program. The DCL software also provides the framework and controls necessary to enable a set software components (i.e., plug-ins) to transform raw

data (i.e., input information) from a sensor into information elements. The DCL software includes at least one software plug-in and a plug-in manager software. The plug-in manager software coordinates the execution of the software plug-ins by providing the input information from the sensors to each plug-in in a specified order. For example, the plug-in manager can be configured to ignore some plug-ins while sending input information to others. The plug-in manager also coordinates the results from the various plug-ins and helps to generate contextual messages for the UI system. For example, the plug-in manager may combine the outputs of software plug-ins to form a contextual message. In some embodiments, the plug-in manager facilitates the exchange of information between the software plug-ins since higher level inferences may be formed through the aggregation of multiple lower level state assessments.

[0014] The software plug-ins (i.e., plug-ins) infer contextual data from the input information provided by the sensors. The plug-ins are generally configured by a user, allowing third party developers to create custom plug-ins for functionality and data types of their choosing.

[0015] As shown in Fig. 1, the data cognition layer (DCL) software transforms input information from the sensors into contextual messages for visual display. The plug-in manager software coordinates the input/output of each plug-in.

[0016] A communication module integrated into the mobile computing device allows for data to be transmitted to, and received from, a remote device. The communication link may be a wired or wireless connection. In some embodiments, the remote device is a database storage system that collects data from the mobile computing device and stores it for additional processing or later access. For example, a plurality of information elements stored in this database storage system could be accessed for higher level analysis of a business process or operation. The results of this analysis could be provided to companies in order to help them understand more about a user's behavior and with the goal of enhancing productivity.

[0017] In some embodiments, the DCL software's functions are split between the mobile computing device and a remote computing device located on a network to which the mobile computing device is connected to via its communication module. Inferences occur in the network (i.e., cloud) by the cloud DCL software while plug-in management is executed on the mobile computing device by the local DCL software executed by the processor.

[0018] In an exemplary embodiment, a mobile computing device (i.e., MCD) running the software application is configured with a plug-in for verifying a customer's age from a barcode on the customer's driver's license. Here the MCD's sensor is a digital camera for obtaining real time images of its field of view. These images are passed to the plug-in. When the plug-in recognizes a barcode within an image it decodes it. Presenting this decoded

information directly to a user, however, would be of limited use. The age information in the decoded barcode data may be (i) embedded within a long string, (ii) unlabeled, or (iii) otherwise presented in a way difficult for a user to recognize. This software plug-in, however, is configured to recognize this decoded barcode data and transform this data into a set of information elements including age. The information elements are converted into a contextual message. In this example, the driver's license barcode is scanned for verification (e.g., to answer the question, "is this person over 21?"). The resulting contextual message is presented for display. Fig. 2 shows the result of this embodiment. Here the barcode 12 on the driver's license 13 is scanned and a contextual message 14, "over 21," is shown on a display overlaid on the barcode within the camera's real time image of the field of view 15.

[0019] Sometimes the contextual messages will include prompts for a user to take some action. Much like the previous embodiment, in this embodiment the mobile computing device is configured with a digital camera as the sensor. The images from the digital camera are displayed on a touch screen display. The input information for the software application includes digital images from the digital camera as well as touch signals from the touch screen display. The software application passes images from the digital camera to the plug-in. The plug-in passes these images back unprocessed until some data within an image is recognized. This recognition occurs when the user positions the camera's field of view so that the patient's barcoded arm band is within the field of view. The plug-in recognizes the barcode and decodes it. In this case the decoded information represents a more complicated data set and may not all be of interest to a user. Rather than presenting all the information at once, the contextual message includes a prompt for user response. As shown in Fig. 3, the contextual message 17 includes a prompt 18 that reads, "tap for allergies." If the user needs this allergy information, then this icon can be touched to initiate its retrieval. The act of touching creates a signal for the DCL software program to respond to by displaying the allergy information. This allergy information may be displayed as an overlay on the real-time video images of the digital camera 20.

[0020] The previous embodiments used a digital camera as the sensor and a touch screen as the display and user input mechanism. Other embodiments, however, can be conceived that use different sensors for these purposes expanding the data cognition beyond simple translation of barcode data. These sensors include sensors for recognizing objects. Sensors for detecting user behaviors such as motion, touch, voice, and gaze are also within the scope of the present invention. Global positioning (GPS) and real-time locating (RTL) sensors may be used and are especially important when the mobile computing device is worn. Wearable form factors could include smart watches and/or glasses.

[0021] Figures 4 and 5 schematically depict two exem-

plary mobile computing devices 21 in accordance with the present disclosure. The mobile computing device 21 typically includes a processor 25, a memory 26, a user interface system 22, and a communication module 31.

5 The user interface system having at least one input sensor 23 for gathering input information and a visual display for rendering information. The processor 25 is communicatively coupled to the memory 26, the input sensor 23, the visual display 24, and the communication module 31.

10 **[0022]** Exemplary mobile devices may include a system bus 29 and/or one or more interface circuits (not shown) for coupling the processor 25 and other components to the system bus 29. In this regard, the processor 25 may be communicatively coupled to each of the other components via the system bus 29 and/or the interface circuits. Similarly, the other components (e.g., the memory 26, the input sensor 23, the visual display 24, and the communication module 31) may each be communicatively coupled to other components via the system bus 29 and/or the interface circuits. Other embodiments of system bus architecture providing for efficient data transfer and/or communication between the components of the device may also be employed in exemplary embodiments in accordance with the present disclosure.

15 **[0023]** The processor 25 is configured to execute instructions and to carry out operations associated with the generation, display and interaction with contextual messages generated by a data cognition layer software program 27 stored in memory 26. The memory 26 generally provides a place to store computer code and data that are used by the mobile computing device 21. The memory 26 may include Read-Only Memory (ROM), Random-Access Memory (RAM), a hard disk drive, and/or other non-transitory storage media.

20 **[0024]** The user interface system 22 includes one or more components capable of interacting with a user (e.g., receiving information from a user or outputting information to a user). As depicted in Figure 4, the user interface system 22 includes a visual display 24. Typically, the visual display 24 is a touchscreen, which is capable of displaying visual information and receiving tactile commands from a user (e.g., selections made by touching the screen with a finger or a stylus, by pointing at a desired selection, or by looking at a desired selection for a pre-defined period of time). In addition to the visual display 24, the user interface system 22 may also include one or more speakers, buttons, keyboards, and/or microphones.

25 **[0025]** As noted, the mobile computing device 21 typically includes a communication module 31. The communication module 31 enables the mobile computing device 21 to communicate with a remote device 33. This communication link 32 may be wired or wireless and the remote device 33 may be directly connected or connected via a network 36.

[0026] The input sensor 23 is typically a digital camera and is able to capture still photographs and/or video. Al-

though Figs. 4 and 5 depict the mobile computing device 21 as having a single input sensor 23, it is within the scope of the present invention for the mobile computing device 21 to include more than one input sensor. When more than one input sensor is used, the sensors may be different in their construction, mode, or means. Alternatively the sensors could be duplicates.

[0027] The processor 25 is configured by software application and software plug-ins stored in memory 26 to perform data cognition algorithms in order to transform low level data into meaningful contextual messages (*i.e.*, data cognition). In the embodiment shown in Fig. 4, the program code to enable this transformation is stored locally on the mobile computing device 21. In the embodiment shown in Fig. 5, however, the data cognition occurs on a remote computing device 35 running a software application (*i.e.*, cloud data cognition layer software program 37) and connected to the mobile computing device 21 via a network 36 (*i.e.*, cloud). The mobile computing device's local software application (*i.e.*, local data cognition layer software program 34) would perform tasks other than data cognition (e.g., coordinating communication with cloud data cognition layer software program 37). In this embodiment, the software plug-ins could be stored remotely in a remote computing device 35.

[0028] The data collected and transformed into contextual messages could be stored locally on the mobile computing device 21 or could be communicated to a remote device 33 for storage. This remote device 33 could house and manage a database. It is envisioned that this database of information could form the basis of further data cognition.

[0029] The present disclosure addresses the problem that workers are faced with a variety of pieces of information as they go about their jobs. Each piece of information can be used individually or in combination to help the worker be more productive. Barcode scanners and mobile computers are commonly used by workers to enhance productivity. Increasingly smartphones and tablets are being adopted due to their form factor, computing power, rich developer application programming interfaces (*i.e.*, API) and their combination of sensors and a display. New wearable form factors are being introduced such as smart watches and glasses. The goal is to increase productivity, and one way to do that is to present actionable alerts and information to the user at the moment in time that the user is able to consume the information. The most pertinent information may be formed only by aggregating a number of lower level pieces of information into a higher level inference. Inferences may occur in real-time on a mobile or wearable device, or they may occur in the cloud. Inferences may trigger immediate feedback to the user to help him understand the world around him. Alternately a plurality of pieces of information could be collected in a database for higher level analysis of a business process or operation, and the results of that analysis could be provided to companies to help them understand more about how their workers behave

with the goal of enhancing productivity. Ideally all of this will be accomplished in a standardized manner that allows third parties to contribute their own solutions, and for users to select an arbitrary collection of solutions from a marketplace of available solutions.

[0030] Barcodes today have many purposes in addition to simply identifying products in a retail environment. They can contain many different types of data like web URLs, TWITTER® accounts, FACEBOOK® accounts, telephone numbers, shipment tracking info, email addresses, Wi-Fi network info, and any other type of data that might be useful within a data collection system. This has resulted in a variety of barcode scanning applications for smartphone platforms, as well as a number of APIs for developers to incorporate barcode scanning into their applications. Many of these APIs are adequate for identifying a barcode and retrieving its encoded data, but few attempt to understand the data that is being scanned. Few, if any, facilitate real-time user interaction with a just-in-time user interface (*i.e.*, UI) that is custom tailored to the data type recognized. Furthermore, none of these solutions allow third party developers to create plug-ins providing this functionality for a data type of their choosing. The software described in the present disclosure would fill this gap. Here data cognition goes beyond simple translation of barcode data. Rather, the software application disclosed can deduce context from multiple cues, including singular or plural machine-recognizable objects in the field of view of a camera. Also user behaviors such as motion, touch, voice, and gaze may be used to deduce context. In addition, user location such as GPS or other real-time locator services may be used. Ultimately the software application disclosed presents relevant context-sensitive data to the user so that the user can take appropriate action (or take no action as needed) for improved productivity. The disclosed software architecture is an implementation that makes this possible.

[0031] The software application disclosed (*i.e.*, the data cognition layer or DCL) is a plug-in framework. The DCL attempts to understand the type of barcode data being scanned and provides the user with context sensitive options for the scanned data type. This is done by filtering the data through all DCL plug-ins that are registered within the system. A DCL plug-in has the responsibility to determine what type of data it is capable of acting on and to quickly return if it does not recognize the data. It has the ability to render its own user interface (UI), which is overlaid on top of a real-time preview of what the camera is currently viewing. This UI can detect single screen touches, multi-touches and even gesturing. The UI may also detect glances and stares and track the direction of the user's gaze. The UI may also detect voice commands. This gives a DCL plug-in the ability to execute logic on only data that it understands and provide a just-in-time UI to the user based on the particular data type. This lets us modularize our middleware and provides a very context sensitive UI experience. The DCL is extensible to allow third party developers to create their

own plug-ins for a custom look and feel that is tailored to match their particular application aesthetics. Each plug-in may maintain data that describes the context, so that it can react differently under different contexts. Plug-ins may be designed to exchange data with one another since higher level inferences may be formed through the aggregation of multiple lower level state assessments.

[0032] The data cognition layer is implemented by utilizing a plug-in manager class that is responsible for loading and unloading all DLC plug-ins with the system. This plug-in manager is also responsible for all communication to/from the registered plug-ins within the system. All DCL plug-ins will be derived from the same DCL plug-in base class, which may require certain methods to be implemented. This could be done relying on known computer science design patterns (e.g., abstract and/or protected methods, interfaces, etc.).

[0033] The data cognition provided by the DCL and the plug-ins augments the user's current context with context-relative information that the user needs to be more productive. The system seeks to overlay meaningful information on a real-time camera view.

[0034] As the user moves about the camera view is changing in real-time and the data cognition system is looking for pieces of information that it recognizes. These may be an object that it recognizes (e.g., a barcode) or a user behavior such as touch, voice, or eye movement. It could be the user's current location. These pieces of information, (i.e., information elements) are converted into context. In much the way different arrangements of atoms form different molecules, the disclosed system recognizes different arrangements of information elements as unique context. Ultimately it is the goal of the disclosed system to selectively present just that information that the user needs at that point of time to make him more productive and more efficient. The display of every piece of information could overwhelm the user, so the system aggregates a plurality of information elements that leads to higher-level inferences, and attempts to display that which is pertinent.

[0035] Different workers operate in different environments, and their jobs exist in different contexts. What is pertinent to each worker varies by profession. Companies have formed to specialize in one type of work or another, and they have developed an expertise in the way that those workers consume information. Thus it is not practical for one company to be able to make high level inferences that are pertinent to every worker. The DCL embodies an architecture that allows multiple companies to develop solutions for a certain type of worker. Multiple companies can develop plug-ins to (a) understand what information is pertinent, (b) making high level inferences, and (c) augmenting the worker's environment.

[0036] Barcodes are commonly used as a tool to reduce errors and to make users more productive by tagging items with machine readable codes. Barcode recognition is an example of information that a vision system

can capture. At the lowest level the barcode contains a collection of numbers and letters and bytes. For example, a tracking number barcode might contain the data "1Z4YE7510220565189". Presenting that information to a user will likely not make that person more productive. However, the data cognition layer might recognize that as a tracking number and extract the information that the worker needs: the entity that shipped the package, the class of service, the unique package identifier. It could perform checking to be sure that the tracking number is valid. What gets presented to the user generally depends on the user's job. For example, the worker may only need to know the class of service. A well-designed DCL system would recognize the presence of a tracking barcode, parse the pertinent information, and display that to the user. For example the class of service could be displayed as "UPS United States Next Day Air" or it could be displayed as a graphic representation of a red colored jet airplane to indicate Next Day Air service. The graphical overlay will augment the camera's field of view and the pertinent information would be displayed as an overlay on the real-time camera view. As an example of a well-designed DCL system, the overlay might be suppressed from display until the user's gaze settles on the barcode. The overlay might be suppressed from display until a user issues a voice command such as "Display Class of Service".

[0037] Barcode symbology standards have been written to describe how to encode certain data characters into bar code format. Industry standards have been written to describe how to use barcodes as a carrier for pertinent business information. Different DCL plug-ins will be responsive to different types of stimulus, and will extract the pertinent information, and will display in a way that is useful to a worker of a consumer of information. One manufacturer may be an expert at barcode recognition and understands a plurality of industry standards, while other third party developers may recognize different object types and different industry standards. The DCL architecture is the framework that allows an arbitrary collection of plug-ins to operate contemporaneously, so that the system is constantly seeking to recognize and aggregate information elements and to present pertinent information to the user. A user will purchase and use the DCL plug-ins that he feels add the most value to his job.

[0038] When a barcode scanning operation is initiated by the application, a real-time camera preview UI is displayed which is used as a viewfinder by the user. On top of this, the transparent DCL UI layer is displayed. This is the layer that gets drawn upon by all DCL plug-ins registered within the system. At this point all DCL plug-ins get initialized. Once a barcode is found by the decoder, the result is iteratively passed to all DCL plug-ins. Each DCL plug-in then checks whether it is capable of acting on the data. If it understands the data, then some plug-in specific task is performed. This could be the parsing and formatting of the data into an easy to use object which is returned to the calling application. It could be the

launching of a third party application that knows how to handle the particular data. Or, it could be, but is not limited to, the rendering of a custom UI that may (or may not) expect further user interaction. In any event, it is the plug-in's responsibility to return both context and any data to the calling application once it has run to completion. Each plug-in also has the ability to determine how often the UI is refreshed and if any other plug-ins should be allowed to process the data after it is done with it.

[0039] To supplement the present disclosure, this application incorporates entirely by reference the following patents, patent application publications, and patent applications:

- U.S. Patent No. 6,832,725; U.S. Patent No. 7,128,266;
- U.S. Patent No. 7,159,783; U.S. Patent No. 7,413,127;
- U.S. Patent No. 7,726,575; U.S. Patent No. 8,294,969;
- U.S. Patent No. 8,317,105; U.S. Patent No. 8,322,622;
- U.S. Patent No. 8,366,005; U.S. Patent No. 8,371,507;
- U.S. Patent No. 8,376,233; U.S. Patent No. 8,381,979;
- U.S. Patent No. 8,390,909; U.S. Patent No. 8,408,464;
- U.S. Patent No. 8,408,468; U.S. Patent No. 8,408,469;
- U.S. Patent No. 8,424,768; U.S. Patent No. 8,448,863;
- U.S. Patent No. 8,457,013; U.S. Patent No. 8,459,557;
- U.S. Patent No. 8,469,272; U.S. Patent No. 8,474,712;
- U.S. Patent No. 8,479,992; U.S. Patent No. 8,490,877;
- U.S. Patent No. 8,517,271; U.S. Patent No. 8,523,076;
- U.S. Patent No. 8,528,818; U.S. Patent No. 8,544,737;
- U.S. Patent No. 8,548,242; U.S. Patent No. 8,548,420;
- U.S. Patent No. 8,550,335; U.S. Patent No. 8,550,354;
- U.S. Patent No. 8,550,357; U.S. Patent No. 8,556,174;
- U.S. Patent No. 8,556,176; U.S. Patent No. 8,556,177;
- U.S. Patent No. 8,559,767; U.S. Patent No. 8,599,957;
- U.S. Patent No. 8,561,895; U.S. Patent No. 8,561,903;
- U.S. Patent No. 8,561,905; U.S. Patent No. 8,565,107;
- U.S. Patent No. 8,571,307; U.S. Patent No. 8,579,200;

- U.S. Patent No. 8,583,924; U.S. Patent No. 8,584,945;
- U.S. Patent No. 8,587,595; U.S. Patent No. 8,587,697;
- U.S. Patent No. 8,588,869; U.S. Patent No. 8,590,789;
- U.S. Patent No. 8,596,539; U.S. Patent No. 8,596,542;
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- U.S. Patent No. 8,600,167; U.S. Patent No. 8,602,309;
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- U.S. Patent No. 8,628,015; U.S. Patent No. 8,628,016;
- U.S. Patent No. 8,629,926; U.S. Patent No. 8,630,491;
- U.S. Patent No. 8,635,309; U.S. Patent No. 8,636,200;
- U.S. Patent No. 8,636,212; U.S. Patent No. 8,636,215;
- U.S. Patent No. 8,636,224; U.S. Patent No. 8,638,806;
- U.S. Patent No. 8,640,958; U.S. Patent No. 8,640,960;
- U.S. Patent No. 8,643,717; U.S. Patent No. 8,646,692;
- U.S. Patent No. 8,646,694; U.S. Patent No. 8,657,200;
- U.S. Patent No. 8,659,397; U.S. Patent No. 8,668,149;
- U.S. Patent No. 8,678,285; U.S. Patent No. 8,678,286;
- U.S. Patent No. 8,682,077; U.S. Patent No. 8,687,282;
- U.S. Patent No. 8,692,927; U.S. Patent No. 8,695,880;
- U.S. Patent No. 8,698,949; U.S. Patent No. 8,717,494;
- U.S. Patent No. 8,717,494; U.S. Patent No. 8,720,783;
- U.S. Patent No. 8,723,804; U.S. Patent No. 8,723,904;
- U.S. Patent No. 8,727,223; U.S. Patent No. D702,237;
- International Publication No. 2013/163789;
- International Publication No. 2013/173985;
- International Publication No. 2014/019130;
- U.S. Patent Application Publication No.

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[0040] In the specification and/or figures, typical embodiments of the invention have been disclosed. The present invention is not limited to such exemplary embodiments. The use of the term "and/or" includes any and all combinations of one or more of the associated listed items. The figures are schematic representations and so are not necessarily drawn to scale. Unless otherwise noted, specific terms have been used in a generic and descriptive sense and not for purposes of limitation.

Claims

1. A mobile computing device comprising:
 - a user-interface (UI) system comprising (i) input sensors for capturing input information and (ii) a visual display for displaying digital images and contextual messages;
 - a memory for storing a data cognition layer (DCL) software program;
 - a communication module for transmitting and receiving information to and from a remote device; and
 - a processor communicatively coupled to the UI system, the memory, and the communication module, the processor configured for executing the DCL software program to (i) receive the input information from the input sensors, (ii) recognize the input information, (iii) transform the input information into information elements, (iv) convert the information elements into contextual messages, and (v) transmit the contextual messages to the UI system for display.
2. The mobile computing device according to claim 1, wherein the DCL software program comprises (i) software plug-ins for creating contextual messages from the input information and (ii) a plug-in manager software for coordinating the execution of the software plug-ins and the software plug-in communication.
3. The mobile computing device according to claim 2, wherein the plug-in manager software facilitates the exchange of information between the software plug-ins.
4. The mobile computing device according to claim 2, wherein the contextual message comprises a combination of outputs from software plug-ins.
5. The mobile computing device according to claim 1, wherein the user-interface system's input sensor comprises a digital camera.
6. The mobile computing device according to claim 5, wherein the visual display's digital images comprise

real-time video images of the digital camera's field of view.

7. The mobile computing device according to claim 6, wherein the visual display's digital images comprise the contextual messages superimposed over the real-time video images. 5
8. The mobile computing device according to claim 7, wherein the user-interface system's input sensor comprises a touch screen, and the input information comprises multi-touch gesture information. 10
9. The mobile computing device according to claim 5, wherein the input information comprises barcode information. 15
10. The mobile computing device according to claim 5, wherein the input information comprises a user's behavior. 20
11. The mobile computing device according to claim 1, wherein the contextual messages comprise prompts requesting a user response. 25
12. The mobile computing device according to claim 1, wherein the user-interface system's input sensor comprises a barcode scanner, and the input information comprises barcode information. 30
13. The mobile computing device according to claim 1, wherein the user-interface system's input sensor comprises a global positioning system (GPS) receiver, and the input information comprises location information. 35
14. The mobile computing device according to claim 1, wherein the user-interface system's input sensor comprises a real-time locating system (RTLS) device, and the input information comprises location information. 40
15. The mobile computing device according to claim 1, wherein the user-interface system's input sensor comprises a microphone and the input information comprises voice information. 45

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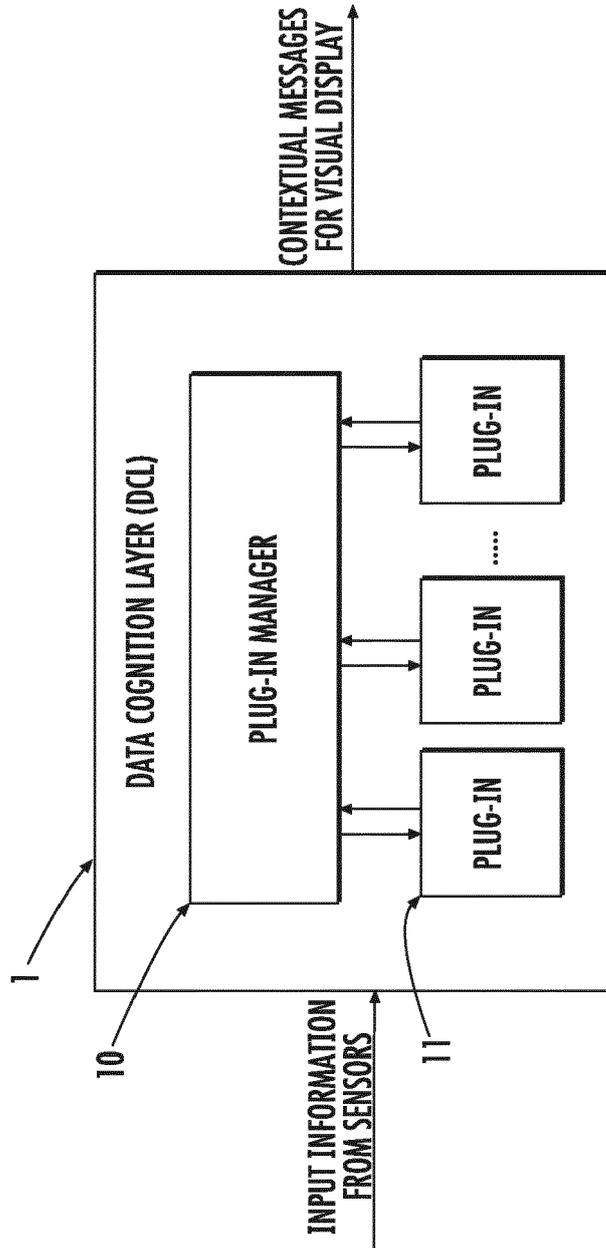


FIG. 1

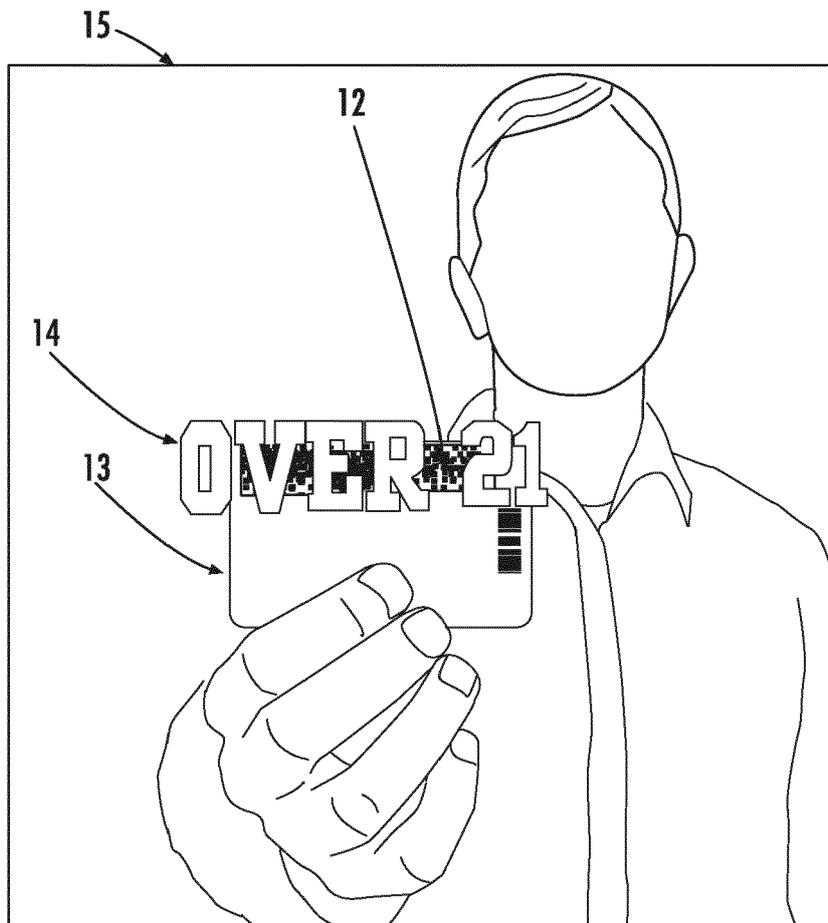


FIG. 2

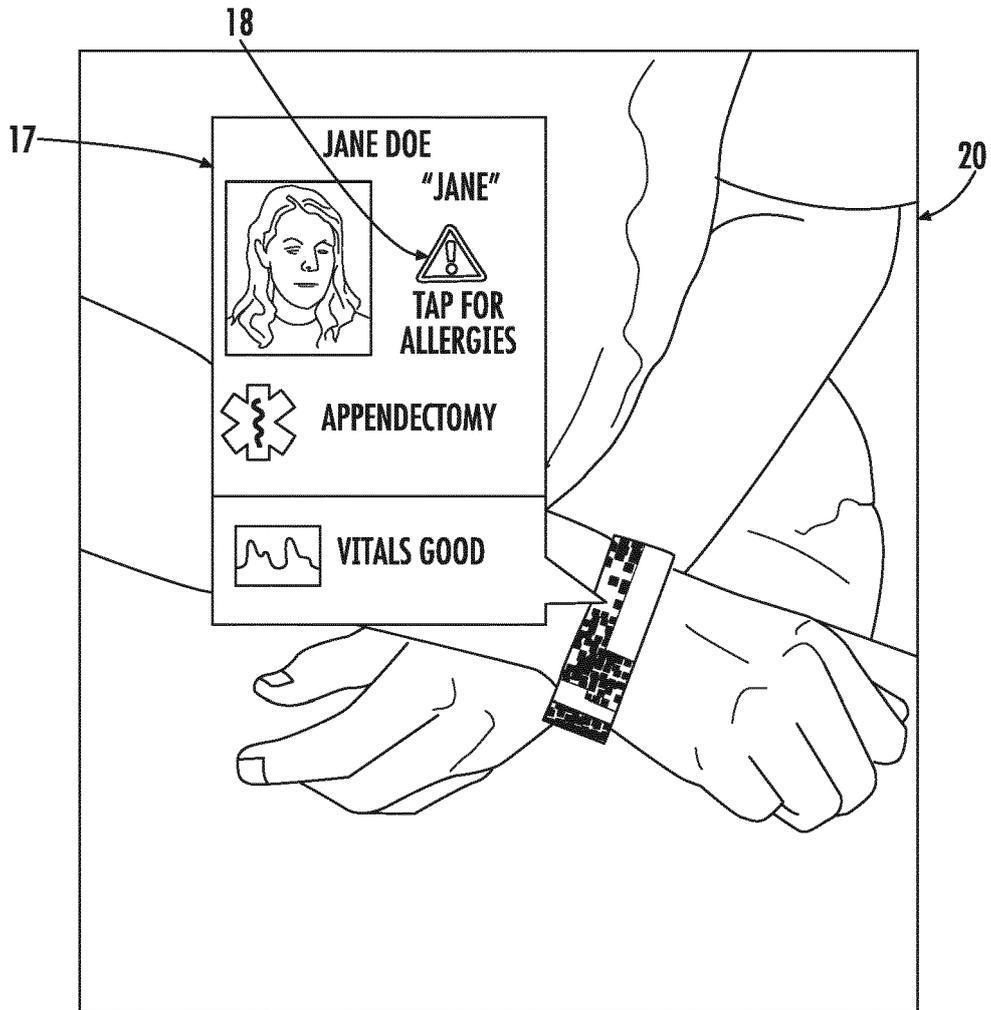


FIG. 3

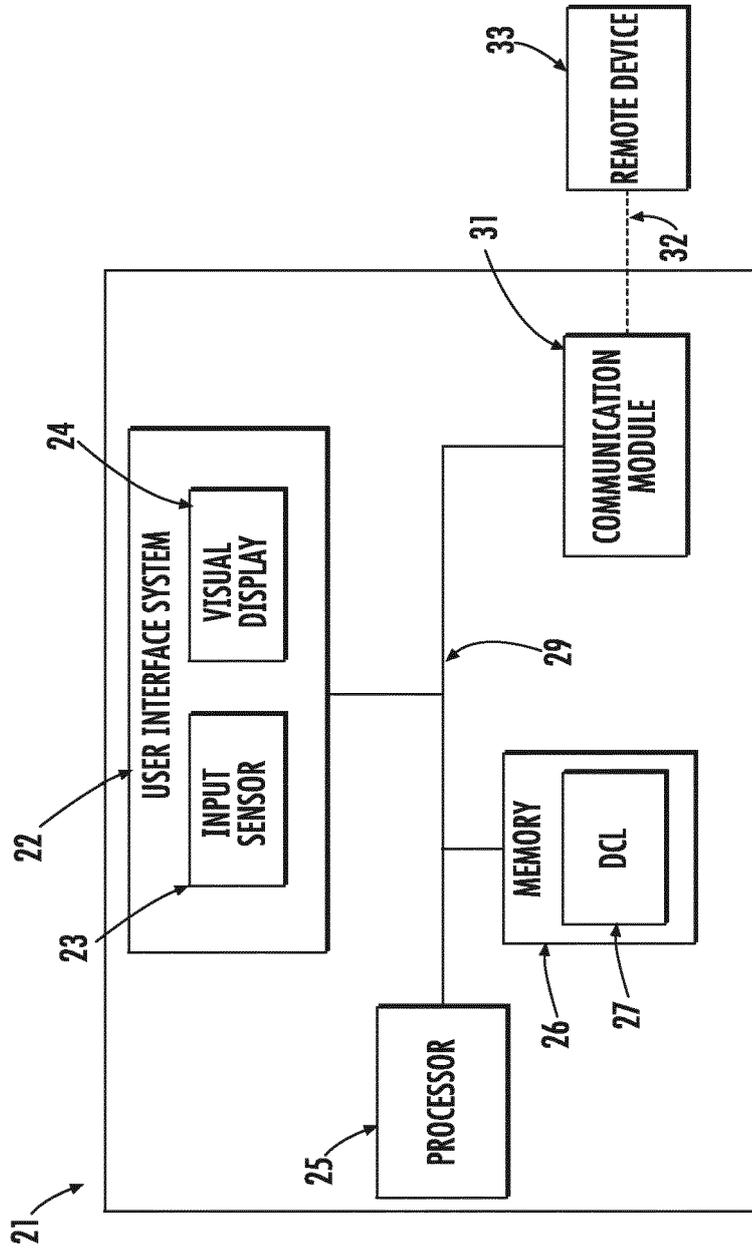


FIG. 4

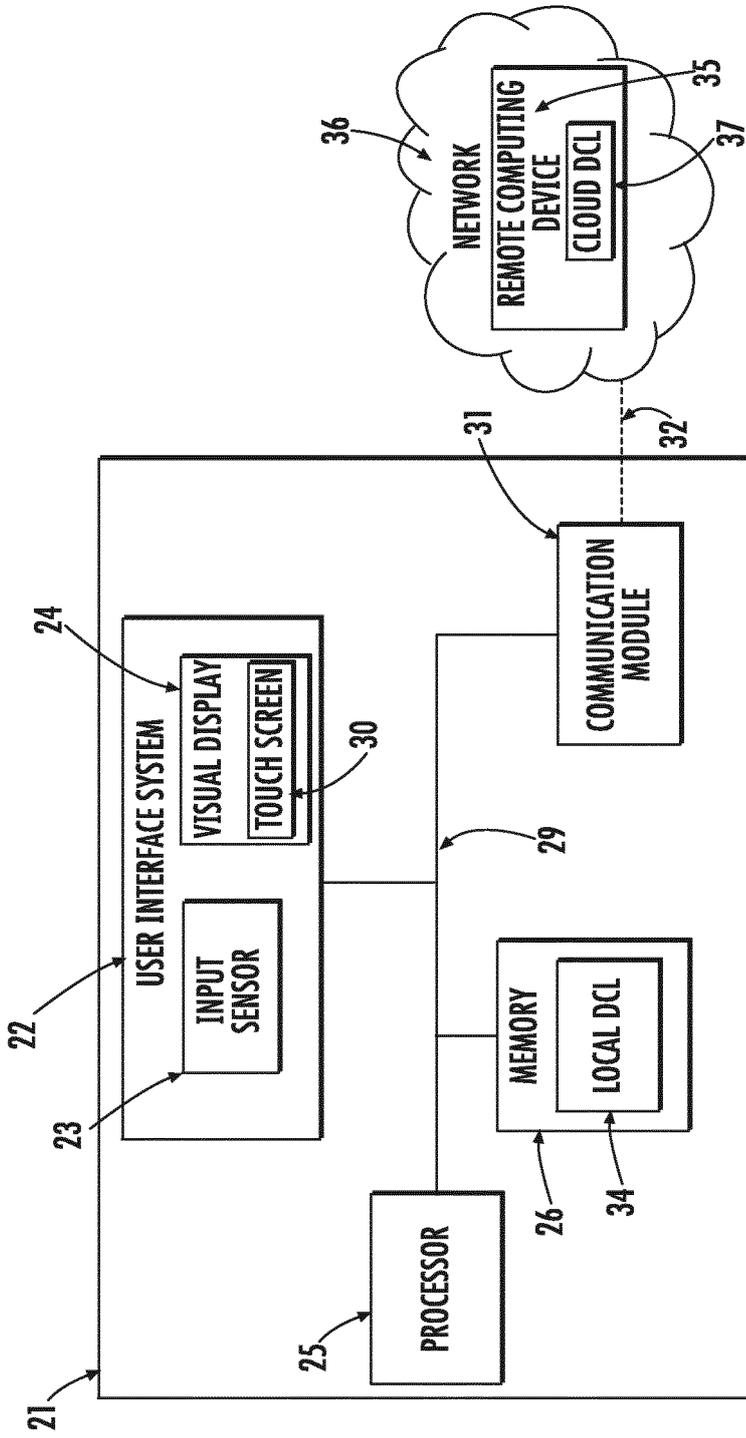


FIG. 5



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Place of search Munich		Date of completion of the search 12 January 2016	Examiner Del Chiaro, Silvia
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